CLAIMS

What is claimed is:

1. A method of characterizing conditions in a tissue, comprising

(a) providing light in selected wavenumbers within the range of mid-IR spectrum;

(b) directing the light to an area of tissue at a location;

(c) collecting light reflected from the location and generating a reflectance spectra; and

(d) comparing said reflectance spectra to a reference spectra of normal tissue, whereby a location having an increased number of absorbance peaks at said selected wavenumbers indicates a tissue containing a physiological marker.

2. The method of claim 1 wherein the step of providing light comprises the use of a mid-infrared source.

3. The method of claim 1 wherein the directing step comprises introducing the light into the blood vessel of a test subject.

4. The method of claim 3, wherein the light is directed into said blood vessel of a test subject via a catheter.

5. The method of claim 1 wherein the comparing step comprises that increased numbers of absorbance peaks at said selected wavenumbers is in the range of wavenumbers 4000 to 400 cm^{-1}.

6. The method of claim 1 wherein the comparing step comprises that increased numbers of absorbance peaks at said selected wavenumbers are within at least one range of mid-infrared wavenumbers selected from the group of: ~3500-3000, ~3020-3000, ~2950-2800, ~1800-1450, ~1710-1760, ~1690-1610, ~1520-1500, ~1480-1450, ~1100-900 and ~900-400 cm^{-1}.

7. The method of claim 1 wherein the comparing step comprises that increased numbers of absorbance peaks at said selected wavenumbers are in the range between ~3000-3100 cm^{-1} and between ~1710-1760 cm^{-1}.

8. The method of claim 3 further comprising the step of generating a spatially resolved map of reflectance generated spectral signals from different locations within a single vessel.

9. The method of claim 1 wherein the presence of said physiological marker in said tissue is an indicator of disease tissue.

10. An apparatus for characterizing tissue conditions, comprising:

(a) a single or multiple source of mid-IR light covering a range of mid-infrared wavenumbers;

(b) a catheter coupled to said source and a detector to detect light reflected by a tissue;

(c) a computer means for generating the reflectance generated spectra at selected wavenumbers detected by said detectors.

11. The apparatus of claim 10 wherein said computer means has stored therein the reference wavenumber range of 4000 to 400 cm^{-1}.

12. The apparatus of claim 11 wherein said computer means has stored therein at least one of the following reference wavenumber ranges, expressed in cm^{-1}: ~4000-2800, ~3500-3000, ~3020-3000, ~2950-2800, ~1760-1710, ~1690-1610, ~1520-1500, ~1480-1450, and ~1100-900 and ~900-400.

13. The apparatus of claim 10 further comprising an interferometer.

14. The apparatus of claim 10 wherein said catheter comprises a source fiber and a detection fiber having a tip or tip array.

15. The apparatus of claim 10 wherein said catheter can be inserted into the lumen of a patient's blood vessel or other tissues suspected of containing physiological markers indicative of vascular disease or other inflammatory conditions.

16. The apparatus of claim 10 further comprising a tuning system for said source.

17. The apparatus of claim 10 further comprising a cooling means for said detector.

18. The apparatus of claim 17 further comprising the additional use of customized bandwidth and special gain for DC- and/or AC-coupled preamps for the detectors to increase the signal-to-noise ratio of the detectors.

19. A method of characterizing a biological material that has enhanced reflectance and/or spectral features, comprising the steps of:

(a) providing light in selected mid-IR wavenumbers between about 4000 to about 400 cm^{-1};

(b) directing the light through a probe to an area of said biological material;

(c) measuring reflected light returning through the probe over a range of said wavenumbers to generate a pattern of spectral signals representative of said area; and

(d) comparing spectral signals from a reference spectra to the spectral signals from said area for enhanced reflectance and/or spectral features.

20. The method of claim 19, whereby an area of said biological material having enhanced reflectance and increased spectral features is indicative of an atherosclerotic plaque, non-native lipids, inflammatory conditions, increased numbers of leukocytes, lymphocytes and macrophages, accumulations of leukocytes, specifically lymphocytes and macrophages, or accumulation of dead (apoptotic and/or necrotic) cells.

21. A method of spectroscopic diagnosis of tissue comprising:

irradiating a subsurface portion of tissue at a target area with radiation having a frequency within the mid-infrared range, transmitted through a fiber optic cable;

detecting light reflected by the area of tissue in response to the radiation, the light having a range of 4000 cm^{-1} to 400 cm^{-1}; and

analyzing the detected reflectance light to diagnose the tissue including the step of comparing the detected light with reference data.

22. The method of claim 21 wherein the detecting step further comprises collecting the reflected light through the fiber optic cable.

23. The method of claim 21 wherein the irradiation step further comprises a catheter means for insertion of the fiber optic cable in body lumens.

24. The method of claim 21 wherein the fiber optic cable receives light reflected by the tissue and transmits the reflected light to a spectroscopic analysis system.

25. The method of claim 21 further comprising an alternate spectrophotometer to receive the reflected light.

26. The method of claim 21 further comprising the step of rotating the fiber optic cable radially within the body lumens, whereby data is acquired at various target locations radially within the lumen.

27. The method of claim 26 wherein the steps are repeated thereby performing a 360-degree spectral analysis of the body lumens.

28. A method of characterizing conditions in a tissue, comprising the steps of:

delivering mid-infrared bright light to a tissue to be diagnosed,

irradiating said tissue with said bright light,

detecting light reflected by the tissue within the same range of MIR frequencies, and

determining the chemical composition and cellular conditions in the tissue.